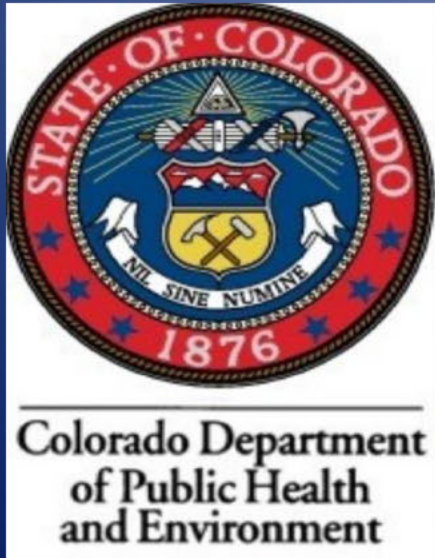


Captain Jack Mill Superfund Site

Subsurface Contamination Remedy
Priority Panel Request
March 2013

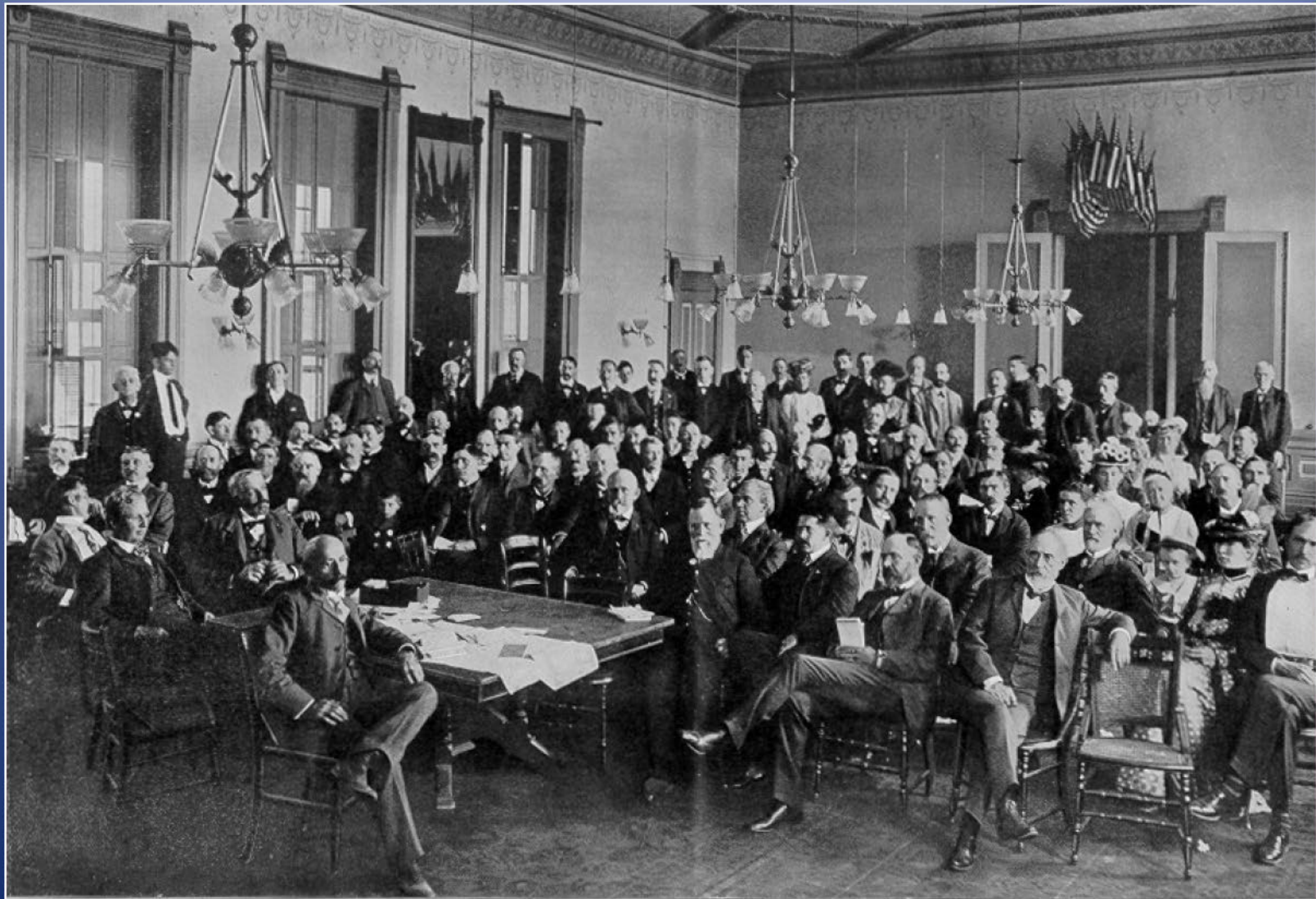


Captain Jack Mill Site: Stats

- Historic gold & silver mining and milling area
 - 1860's intermittently through 1992
- State Lead Site – Colorado (CDPHE)
- Listed on NPL in September of 2003
- ROD signed September 2008
- One OU; Two Phased Remedy
 - Surface Remedy (Phase 1): waste rock, tailings, soils, & abandoned mill buildings
 - Construction completed Nov 2012
 - Consolidated mine waste materials into 2 consolidation cells
 - Subsurface Remedy (Phase 2): AMD from Mine Tunnel
 - Discharging AMD from the Big Five tunnel
 - Innovative: tunnel plugging with an in-tunnel treatment process
 - Addressed in this RA funding request
 - May require Phase 3: external passive bioreactor for polishing

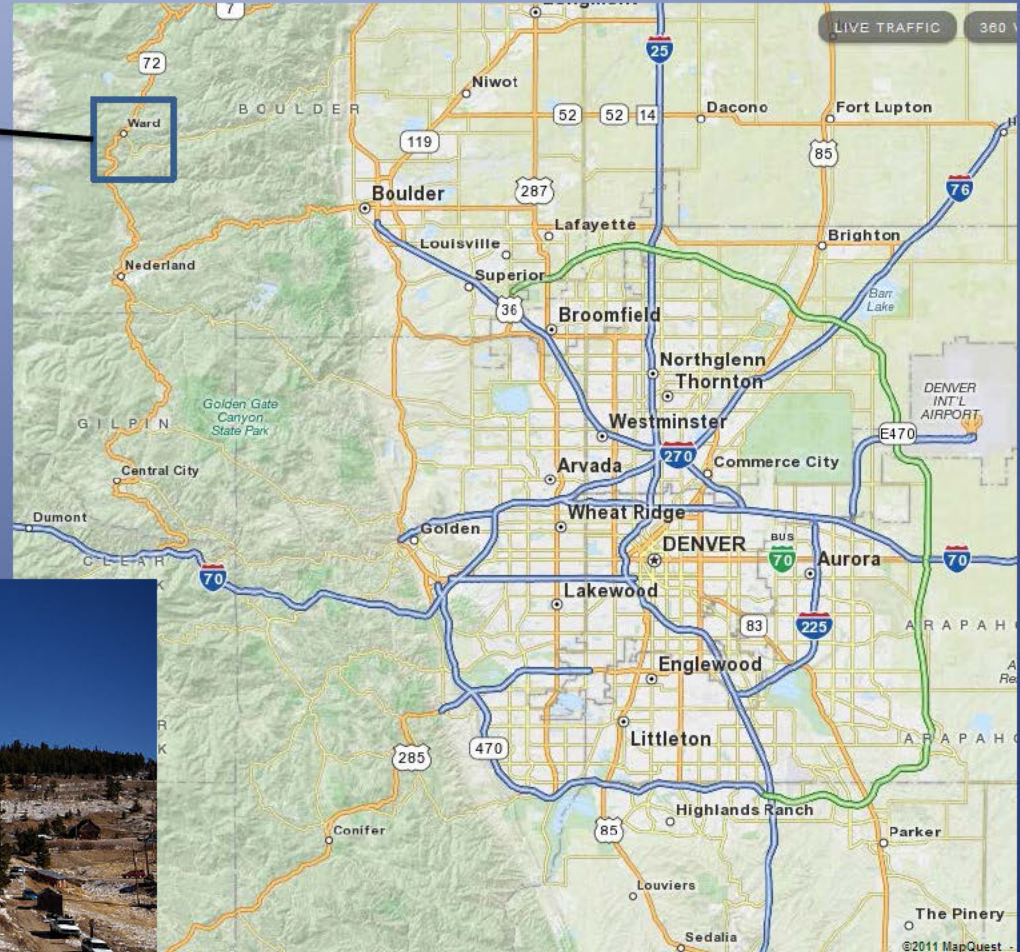
Big Five Stockholder Meeting, Denver, September 1901

Exemption 5: AC, AWP



A MEETING OF BIG FIVE STOCKHOLDERS—Windsor Hotel, Denver, September, 1901.

Site Location



An aerial photograph of a small town nestled in a mountainous region. The landscape is covered in a light layer of snow, with patches of dry grass visible. In the center, a white church with a prominent steeple stands out. To its left, there's a small wooden building, and to its right, a larger building with a green roof. A parking lot with several cars is located near the church. In the foreground, there's a large metal frame structure, possibly for a ski lift or a construction project. The background shows a dense forest of evergreen trees on a hillside. The sky is clear and blue.

Captain Jack Site Features

- Currently 1 permanent residence
- Additional residences along road south side of site
- Recreational use (biking, exploring)
- Private property from mining claims
- BLM & Boulder County property
- Approx image scale: ~0.5 square miles

Big Five Adit –Discharge of ARD to be addressed with phase 2 RA

Big Five Waste Consolidation Cell

Left Hand Creek (follows road)

Black Jack Adit – No significant discharge

Captain Jack Mill Waste Consolidation Cell

Residence

White Raven Adit – No discharge observed

White Raven Waste Pile (excavated during phase 1 RA)



Big Five Pile before and after Phase 1 RA



Captain Jack Mill area before and after Phase 1 RA

Phase 2 Addresses the Big Five Tunnel AMD Discharge



Big Five AMD discharge



Tunnel was rehabilitated as a removal action



Big Five Waste Pile before & after Phase 1 RA; AMD discharge now piped over cover

Remedial Action Objectives (RAOs)

Surface Water

1. Reducing in-stream metals concentrations;
2. Ensuring that in-stream metals concentrations do not degrade drinking water supplies diverted from Left Hand Creek; and
3. Reducing the contaminant pathways to benthic aquatic organisms living at the surface water/sediment interface or contamination in sediment to levels that are protective of aquatic life, with the ultimate goal of attaining surface water standards to ensure long-term survival of fish and benthic aquatic organisms in Left Hand Creek.

Remedial Action Objectives (RAOs)

Groundwater

1. Controlling and/or reducing metals loading to groundwater from surface sources;
2. Ensuring that contaminated groundwater does not adversely impact human health and aquatic ecological receptors; and
3. Ensuring that contaminated groundwater does not adversely impact receiving surface waters.

Phase 1 RA reduced contaminant contributions from surface deposits of mine waste materials. Phase 2, addressing the Big Five tunnel, will further address both surface & groundwater RAO's

Remedy designed to meet surface water quality criteria at a downstream Point of Compliance

Subsurface Remedy (Phase 2)

- Remedy objective is to restore ground and surface waters by treating mine water “in-situ”
- Submerge (to the extent safely practicable) source materials in order to minimize contact with oxygen, and to implement active neutralization of impounded mine-pool water in order to treat continuing long-term acid water inflows

Subsurface Remedy: Components

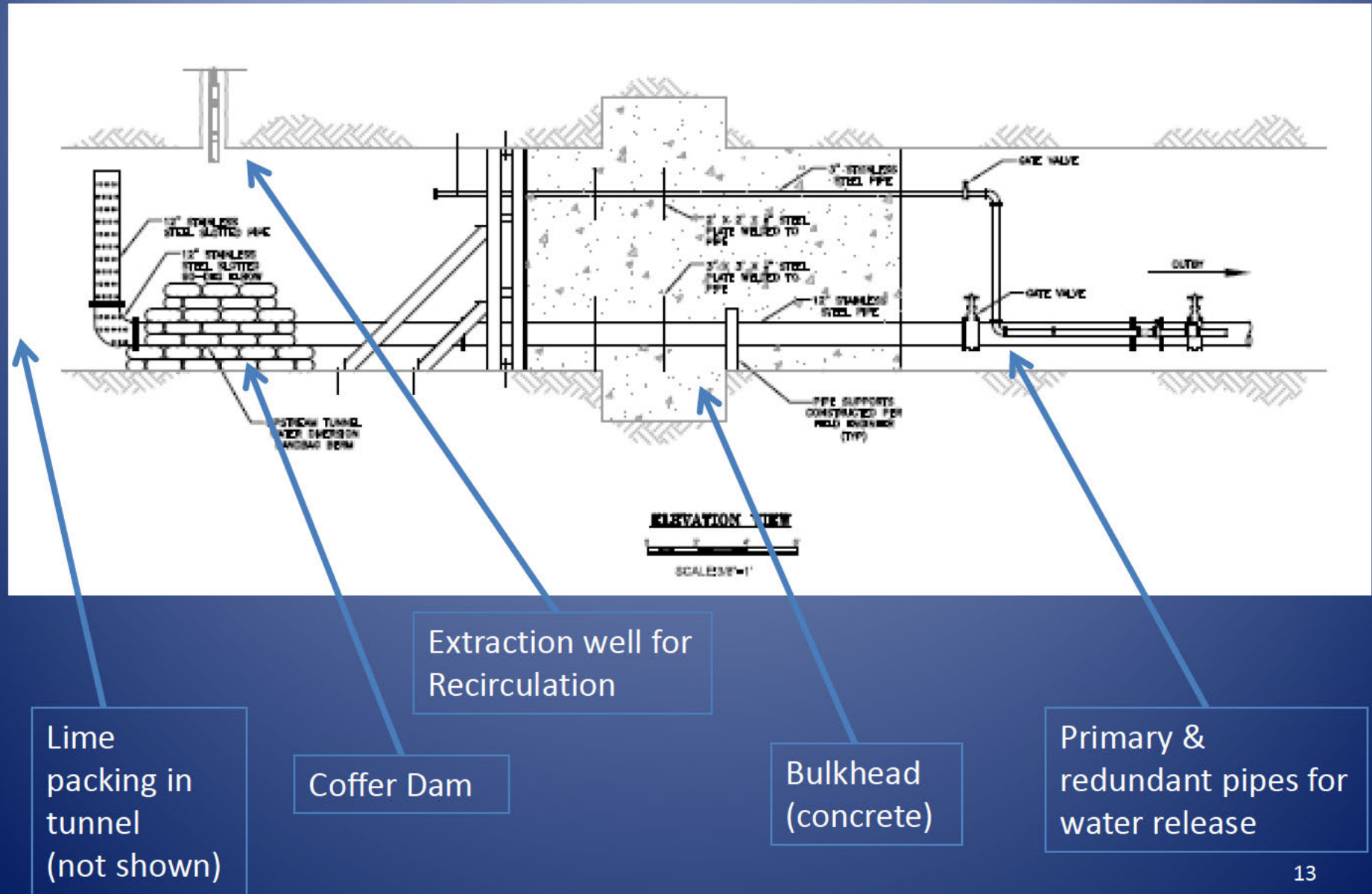
- Construct a flow-through bulkhead approximately 600 feet upstream of adit
- Pack limestone into a section of the tunnel upstream of the bulkhead to provide long-term source of alkalinity
- Submerge source materials to limit oxygen contact & inhibit AMD generation
- Re-circulate mine-pool water through a section of the tunnel
- Allow for the addition of more reactive caustics into the tunnel upstream of the bulkhead
- Treatment (caustic addition & recirculation) is anticipated to be required as the mine tunnel floods, and may be required on a periodic basis thereafter
- Monitor!
- System will be flexible: other amendment types (organic carbon) could be utilized if initial flooding & neutralization do not impede oxidation of AMD generating minerals

Subsurface Remedy: Monitoring

- Comprehensive monitoring system
 - Track changes in groundwater elevation & quality over time to ensure new contaminant sources are not being created (new seeps)
 - Utilize geophysical monitoring arrays (surface & downhole)
 - Install a network of monitoring wells
- Field monitoring
 - Monitor known seeps downgradient of tunnel (currently discharging clean water)
 - Sample Left Hand Creek upstream & downstream of known seep locations



Bulkhead Construction Design with Flow Through Pipe



Subsurface Remedy (Phase 2) (Continued)

- Valved pipe through bulkhead allows release of water from the tunnel should it be necessary
- Phase 3 in ROD (contingency remedy)
 - Allows construction of ex-situ bioreactor system if additional treatment of the mine tunnel discharge is determined to be necessary after a 2-year monitoring period
- This remedy is a novel treatment technology aimed at restoring ground & surface water quality & reducing long term O&M costs for treating mine influenced water

Remedial Action Costs

Remedial Action	Cost	State Share	EPA Share	Schedule
Surface Remedy Phase 1	Complete \$2,000,000	Complete \$200,000	Complete \$1,800,000	RA on Start June 4, 2012
				RA Complete Pending Report
Subsurface Remedy Phase 2	\$3,290,000	\$329,000	\$2,960,000	RA Start FY2013
Subsurface Remedy Phase 3 (if required)	\$2,000,000 (estimated)	\$200,000	\$1,800,000	RA Start FY2016
Total RA Remaining	\$7,290,000	\$729,000	\$6,560,000	---

Remedial Action

- Phase 2
 - One construction season
 - 2-year monitoring to determine if Phase 3 is needed
 - O&F determination at completion of monitoring period
 - 10 year LTRA; remedy identified as restoration in ROD
 - Could be Site Construction Complete if Phase 3 is not needed
 - Costs outlined as Option A in next slide
- IF Phase 3 is needed:
 - Design needed; one construction season
 - Anticipated that bioreactor would be operated in conjunction with in-tunnel treatment
 - Construction Complete anticipated after Phase 3 (if implemented)
 - Costs outlined as Option B in next slide

Exemption 5: DPP

Human Exposure

- **Full Time Residents**

- Currently three people
- Plus three houses just downstream of Site boundary
- Estimated to increase to 12 within 2 – 10 years

- **Transient Residents**

- Estimated at five unique individuals per year

- **Recreational Users**

- Estimated at 20+ unique individuals per year (nearby trails & historic features)
- May be underestimated due to proximity metro area

- **Water Users**

- Residences have unpermitted shallow ground water wells; but not used for drinking water
- Recreational users may contact surface waters
- Left Hand Creek is drinking water source for Left Hand Water District Approximately 15,000 consumers
- Big Five Adit discharges into Left Hand Creek
- Mine tunnel blow out; could cause a temporary shut down of the drinking water plant



Permanent residence amongst mine waste before Phase 1 RA

Contaminant Characteristics & HH Risk

- **Surface Water** (most impacted area):
 - Cadmium: mean 0.00278 ppm, max 0.00726 ppm
 - Copper: mean 0.581 ppm, max 1.42 ppm
 - Iron: mean 22.2 ppm, max 111 ppm
 - Manganese: mean 3.42 ppm, max 7.3 ppm
 - Zinc: mean 0.614 ppm, max 1.46 ppm
- Some sample locations exceed drinking water standards for Cu, Cd, & Mn
- Exposure pathways include waterborne & food chain exposure; ingestion and dermal exposure
- HQs ranged from <1 to 3 for ingestion & dermal exposure
- Cancer risks ranged from 10^{-6} up to 10^{-3} if drinking surface water; location dependent
- Residents are buying drinking water & using shallow groundwater for other uses
- Fish ingestion: excess cancer risks for As & Cr

Environmental Threats

- Left Hand Creek -Class 1
Cold Water Aquatic Life designation
- Aquatic life standards exceeded
 - Cadmium, Copper, & Zinc
- HQs greater than 1 for aquatic life
- Fish & benthic invertebrate populations appear drastically reduced compared to un-impacted streams in area
- Colorado Natural Heritage Program
 - Selected the canyon downstream of the Site to be a Potential Conservation Area due to its significant biodiversity



Contaminant Stability

- AMD from the Big Five tunnel is a constant source of dissolved & particulate metals to Left Hand Creek
- Left Hand Creek is the primary offsite transport mechanism for contaminants
- Metals undergo various reactions in surface water that control the extent of transport diurnally & seasonally
- Tunnel collapse areas could break free
 - Releasing large volume of water at one time
 - Carrying contaminants farther downstream
 - Potentially impacting the drinking water plant intake

Programmatic Considerations

- Innovative technology
 - Flooding mineralized zones reduces oxygen contact leading to reduction in AMD generation
 - Ability to re-circulate the mine water & add amendments to the mine-pool in-situ, allowing in-tunnel treatment/neutralization, is innovative
- Anticipated to reduce the long term O&M costs typical in AMD treatment
 - By reducing generation of AMD & treating in-situ
 - Avoid traditional long term water treatment plant
- Expect to learn information & techniques that could be utilized at other mine sites with the overall goal of reducing mine water treatment costs regionally and nationally
- Additionally, solar power will be utilized to operate much of the monitoring system

Programmatic Considerations (Continued)

- Strong community support
 - Boulder County, Town of Ward, Lefthand Watershed Oversight Group, Lefthand Creek TAG Coalition
- State is lead agency
 - EPA & CDPHE are in full concurrence



Community identified the boarding house as important cultural resource; RA avoids this structure

Questions?



Looking for the light at the end of the tunnel instead of AMD treatment into perpetuity!!